



Eleocharis caduca (Cyperaceae), a new alien species in Montenegro and the Balkan Peninsula

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Received: March 18, 2025 | Accepted: March 24, 2025 | Published: June 13, 2025

Abstract

This paper describes the first find of *Eleocharis caduca* (Cyperaceae) in Montenegro, which is also the first record for the Balkan Peninsula. A large population has been found at one location in Southeast Montenegro, in the coastal area of Long Beach near the village of Donji Štoj. The species is native to Tropical Africa. Some populations of that species are known in the Mediterranean part of Europe (Spain, Portugal, Italy, Crete), but the species' status in Europe remains uncertain. The distribution, morphological features and the habitat preferences of the species are presented. Based on field research, the authors think that the species can be considered a naturalized non-native in the flora of Montenegro that may appear in other parts of the Balkan Peninsula in the future.

Key words

Balkan Peninsula, *Eleocharis*, Cyperaceae, non-native plants

Citation

Mesterházy, A., Romanov, R. & Verloove, F. 2025. *Eleocharis caduca* (Cyperaceae), a new alien species in Montenegro and the Balkan Peninsula. – Phytologia Balcanica, 31: 81-86 -- ISSN 1310-7771 (print), 1314-0027 (online).

Introduction

Eleocharis R. Br. is a nearly cosmopolitan genus, with 200 to 250 species worldwide (Govaerts & al. 2007). Most species (145) are found on the American continent (González-Elizondo & Tena-Flores 2000). According to *Flora Europaea* (Walters 1980), the genus is represented by 15 taxa in Europe, including four alien species, most from the New World (*E. atropurpurea* (Retz.) J. Presl & C. Presl, *E. bonariensis* Nees, *E. flavescens* (Poir.) Urb. and *E. obtusa* (Willd.) Schult.) and one from the Old World tropics [*E. caduca* (Delile) Schult., incorrectly listed at the time as *E. geniculata* (L.) Roem. & Schult.]. Recently, two new adventive species have been found in Europe. In 2002, *E. tenuis* (Willd.) Schult., native to eastern North America, was found in a natural swamp in Germany (Gregor & al. 2004); subsequently, *E. pellucida* J. Presl & C. Presl, na-

tive to Asia, was reported from North Italy and appears to have established itself in a military training area (Verloove 2010). Seven taxa of *Eleocharis* have been found in Montenegro: *E. acicularis* (L.) Roem. & Schult., *E. carniolica* Koch, *E. palustris* (L.) Roem. & Schult., *E. mamillata* (H. Lindb.) H. Lindb, subsp. *mamillata*, *E. mamillata* subsp. *austriaca* (Hayek) Strandh., *E. uniglumis* (Link) Schult., and *E. quinqueflora* (Hartmann) O. Schwarz (Rohlena 1941-1942; Parolly 1995; Hadžiablahović 2004; Pulević 2005; Blaženčić 2007; Vuksanović & al. 2019).

Eleocharis caduca is distributed mainly in Tropical Africa, from East Tropical Africa to South Africa, extending to Madagascar and Mascarene Islands, Socotra and Yemen. There have been scattered occurrences in Sahara (Chad, Niger, Egypt, Libya), but it is missing from West Tropical Africa (Svenson 1929, Greuter & al. 2002; Mesterházy & al. 2022).



Fig. 1. Habitat of community of *E. caduca* in Montenegro (photo by Roman Romanov).

According to Greuter & al. (2002), who provided an extensive account of the taxonomy, nomenclature and distribution of the species, the first European record is from Sardinia, where it was collected in 1827 or 1828. The authors have considered *E. caduca* as apparently extinct in Italy, but subsequently it was rediscovered near Viareggio in Tuscany (Lastrucci & Becattini 2007; Bartolucci & al. 2018). It has recently become apparent that most records of *E. flavescens* from the Iberian Peninsula and Ibiza (Luceño & al. 2007) also refer to this species (Verloove & Sánchez Gullón 2012; Verloove & al. 2024). The presence of *E. flavescens* on the Iberian Peninsula was confirmed only in the Portuguese Baixo Alentejo area (Verloove & al. 2024). *Eleocharis caduca* was also discovered on Crete on the shore of Lake Kournas in 1985 (Greuter & al. 2002) where it has since been re-collected on several occasions. The status of *E. caduca* in Europe is uncertain. Either it is a naturalized alien from Tropical Africa, with some introduced occurrences in the Mediterranean (Verloove & Sánchez Gullón 2010), or the species has gradually expanded its natural African range northwards and the Mediterranean populations can be considered as isolated outposts. In Italy, for example, the species is now treated as part of the native flora (Galasso & al. 2018).

Materials and methods

Field research was conducted on 30th August and 27th October 2023. Herbarium vouchers were collected and deposited in NHMM and BR (Herbarium acronyms according to Thiers 2025). The authors examined the morphology of the species using a stereomicroscope, and photographs were taken in the field. Photos of nutlets

and sheaths were taken by a stacking camera (Keyence VHX5000) with a VH-Z20R/W/T lens. Geographical coordinates were recorded using a GPS device. Nomenclature followed the Euro-Med PlantBase (2025).

Results

Eleocharis caduca was discovered in 2023 in the coastal area of Southeast Montenegro near the village of Donji Štoj (41°53'37.09"N, 19°18'31.07"E). The study site, which harboured an extensive population of *Eleocharis*, was located near Long Beach, the longest sandy beach on the northern Adriatic coast. The site was a Mediterranean temporary pond of artificial origin (Fig. 1). It was inundated in winter and spring with rainwater, reaching a depth of about 0.6-0.7 meters. The water evaporated completely in summer, leaving an open sandy bottom suitable for the colonization by angiosperms. The site is bordered on the seaward side by dense stands of *Cladium mariscus* (L.) Pohl, with relatively straight or regular margins, apparently a result of past cutting and removal of those plants before sand extraction started in the area. That practice appeared to have been abandoned there.

The margin of the *C. mariscus* stands was occupied by *Hydrocotyle vulgaris* L., which did not spread far outside the stands. A few deep depressions within the *C. mariscus* stands were inhabited by *Nymphaea alba* L., growing as a terrestrial plant after water evaporation in the autumn, but not in association with *Eleocharis*. The slightly deeper parts of the pond bed near the *C. mariscus* stands supported sparse plants of *Potamogeton coloratus* Hornem., which grew terrestrially in



Fig. 2. *Eleocharis caduca* from the population discovered in Montenegro (photo by Roman Romanov).

September and October after the rains in late August. Small, sparse stands of *Typha domingensis* Pers., *Phragmites communis* Trin., *Bolboschoenus maritimus* (L.) Palla, and *C. mariscus* outside the dense community of *C. mariscus* were also notable. Other plants sharing the same habitat of sparse herbaceous vegetation with *Eleocharis* included the non-native *Phyla nodiflora* (L.) Greene (most abundant) and *Euphorbia maculata* L. (less common), as well as such native species as *Juncus articulatus* L., *Baldellia ranunculoides* (L.) Parl., *Juncus* spp., *Salix* sp., *Gratiola officinalis* L., *Lythrum salicaria* L., *Mentha aquatica* L., *Samolus valerandi* L., *Lysimachia vulgaris* L., *Schoenoplectus litoralis* (Schrad.) Palla, and *Heliotropium europaeum* L. The area occupied by *E. caduca* was estimated to exceed slightly over 10 000 m². The senescent stems of *Eleocharis* gave the community a light-yellow-brown to ginger tinge from late August to October (Fig. 1).

Description of species

Tufted perennial up to 12 cm (Fig. 2). Stolons 0.8–1.0 mm diam., culms ca. 0.5 mm diam., terete or obscurely trigonous above, lowermost open sheaths disintegrating, lower closed sheath up to ca. 6 mm, the upper up to 2 cm, yellow, brownish or reddish, mouth hyaline, slightly wrinkled to nearly smooth. Spikelets 3–7 × 1–3 mm, obovoid to ellipsoid, greenish-brown, with up to ca. 10 glumes, lax at maturity. Basal glume usually sterile, up to ca. 2 mm, green, subsequently greyish, with scarious margins. Other glumes 2.0–2.3 mm, cylindrical, obtuse, with conspicuous green midrib, veins absent or obscure at sides, brownish, with scarious margins. Perianth-bristles 6–7, ± equal, slightly shorter than or equalling nutlet, colourless to brownish. Stamens 3, anthers ca. 1.4 mm; stigmas 2. Nutlet 0.8–1.0 × 0.6–0.7 mm, broadly obovoid, glossy, obscurely striate and punctate, shiny black at maturity; style-base minute, ca. 0.4 × 0.4 mm, trigonous, white, turning brownish (Fig. 3).



Fig. 3. Nutlet of *E. caduca* (BR0000027059869V, Montenegro, coll: A. Mesterházy) (photo by Iris Van der Beeten).

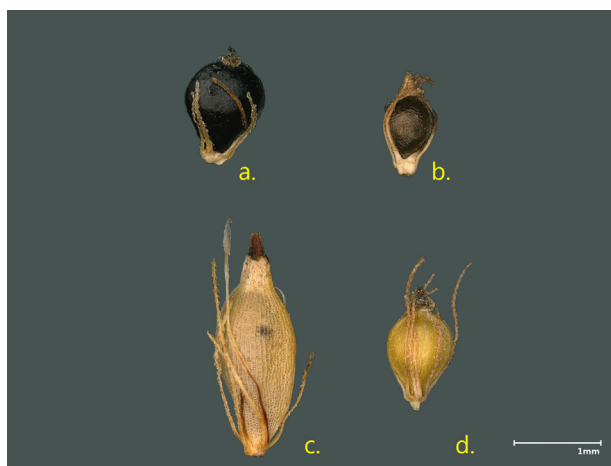


Fig. 4. Nutlets of: **a**, *E. caduca* (BR0000027059869V, Montenegro); **b**, *E. flavescens* (BR515084-Italy); **c**, *E. quinqueflora* (BR0000035422181, Slovakia); **d**, and *E. carniolica* (BR0000035413073, Slovakia) (photo by Iris Van der Beeten).



Fig. 5. Nutlet of *E. flavescens* (BR515084, Italy, coll: F. Verloove) (photo by Iris Van der Beeten).

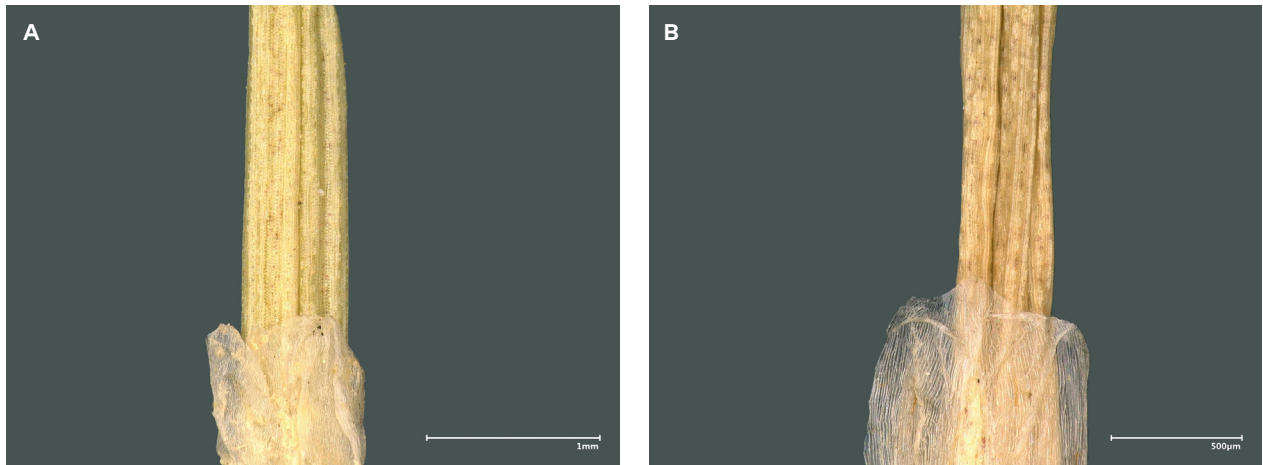


Fig. 6. Upper leaf sheath apex of: **A**, *E. flavescens*; **B**, *E. caduca* (photo by Iris Van der Beeten).

Discussion

Two indigenous *Eleocharis* species in Montenegro may be confused with *E. caduca*: *E. quinqueflora*, which typically has fewer (5–9) flowers, larger (2×1 mm), trigonous, grey (when ripe) nutlets, 3 stigmas, and an elongated style base that is not or is hardly constricted at base. The recently discovered *E. carniolica* also looks similar but it is a caespitose perennial of natural habitats, often proliferating vegetatively, and mature nutlets are pale brown. Nutlets of similar species are presented in Fig 4.

The most similar species, however, is probably *E. flavescens*, native to the warm-temperate and (sub-)tropical regions of the New World and occurring as an alien species in some parts of South Europe. In the early 1970s, it was discovered in North Italy, specifically in the rice fields of Lombardy and Piedmont, and has subsequently become a more or less widespread weed there (Abbà 1979; Conti & al. 2005). Recent records from the rice fields have not been confirmed, but the species was found later (in 1995) in a military training area in the heathlands near Bienna (Verloove & Soldano 2011). Considering that some other alien species were present in that area, the authors suggested that *E. flavescens* was most likely introduced by the military vehicles and was now mostly confined to the protected natural habitats.

Apart from their distinct original distribution ranges (Old World versus New World, respectively), the color of the mature nutlet is the primary distinguishing feature. *Eleocharis flavescens* has two varieties: var. *flavescens*, which has reddish-brown to dark brown ripe nutlets and perianth bristles typically shorter than or as long as the achene; and var. *olivacea* (Torr.) Gleason, which has green to golden-brown ripe nutlets, with perianth bristles typically longer than the nutlet (Smith & al. 2002). *Eleocharis caduca*, in contrast, always has shiny black nutlets at maturity. Furthermore, nutlets tend to be slightly bigger in *E. caduca* (0.8–1.0 vs. 0.4–0.8 mm) with a comparatively tiny style base (Fig. 3). There are subtle differences in the upper leaf

sheath apex too: both species have hyaline leaf sheath apices but in *E. flavescens* the apex is often distinctly wrinkled (rugose), while in *E. caduca* the apex is only slightly or not wrinkled at all (Fig. 6). Finally, spikelets in *E. caduca* tend to be relatively poor-flowered (usually at most 10 glumes vs. up to 60 in *E. flavescens*) and the glumes are erecto-patent and laxly arranged at maturity (vs. remaining \pm erect). Recent phylogenetic analyses using ITS and *matK* sequences has shown that, despite their similarities, these are two distinct species (Verloove & al. 2024).

Eleocharis caduca is the first adventive *Eleocharis* species recorded on the Balkan Peninsula (excluding Crete). The exact vector of introduction is unclear, but only two options seem to be at hand. Possibly, *E. caduca* has been unintentionally brought to the area by machines. Development in the region began in 2019 and excavators were widely used at that time. A second possibility is that the species has been introduced by migratory birds, from known populations in North Africa or, closer to home, Italy. Both options remain speculative, however, especially since the number of known populations in the Mediterranean, from which it could have been introduced, is still limited (although it cannot be ruled out that it is overlooked in many places).

Currently, the species only forms stable populations on areas that have been bulldozed, thus covering an area of approximately 10 000 m². Since its discovery, the population has increased slightly year after year, thus in the authors' opinion the species can be considered a naturalized species. It is crucial to reconsider the known occurrences of *E. quinqueflora* on the Balkan Peninsula, particularly in lowland areas, as *E. caduca* is the species most likely to be confused with *E. quinqueflora* due to similarities in habitat and ecological preferences.

Acknowledgements

Thanks are extended to Iris Van der Beeten (Meise Botanic Garden, Belgium) for providing the photographs of the nutlets and leaf sheaths.

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